Microfluidic Ion Analyzer for Astrobiological Studies

Completed Technology Project (2016 - 2019)

Project Introduction

JPL has made consistent progress over the last decade to develop portable lab-on-a-chip systems for detection of biomarkers with extremely high sensitivity (parts per trillion).1-4 However, the detection method (laser-induced fluorescence, LIF) requires that samples be mixed with dyes that attach to the biomarkers and make them fluoresce. These additional processing steps increase the overall size and complexity of the instrument package. At the same time, it is clear now that an understanding of the chemical environment surrounding potential biosignatures is critical to rationally select proper sample handling and detection methods. This information is also crucial in the process of interpreting the resulting data sets obtained during the analysis. This proposal addresses these points by integrating a universal conductivity-based detector into a lab-on-a-chip system that can search for salts and biomarkers simultaneously while greatly simplifying both the instrument and its operation.Our proposal is built upon three key research objectives: O1 - Development of protocols for simultaneous analysis of inorganic and organic ions with ME-C4D. (Initial TRL 2, final TRL 4) O2 - Demonstration of analysis on inorganic and organic ions by ME-C4D in relevant environmental samples. (Initial TRL 2, final TRL 4) O3 – Design of a miniaturized ME-C4D instrument dedicated to simultaneous analysis of inorganic and organic ions. (This work will leverage from instruments previously developed in our laboratory, initial TRL 3, final TRL 4) This effort will provide the capability to detect ionic species directly in liquid samples or following extraction from solid samples, or melting of ice samples (i.e. from the surface or jets of Enceladus or Europa). Samples are simply dissolved in the appropriate buffer and analyzed by microchip electrophoresis coupled to contactless conductivity detection. We will develop protocols for simultaneous analysis of both inorganic and organic ions with a single miniaturized instrument and without labeling. This new capability will provide a major leap forward in NASA's ability to obtain the chemical composition of Martian regolith as well as Europa's subsurface ocean. The ionic composition will help us understand the chemical processes and the possibility of past and present life in these targets highly relevant to future in situ missions.

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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Planetary Instrument Concepts for the Advancement of Solar System Observations

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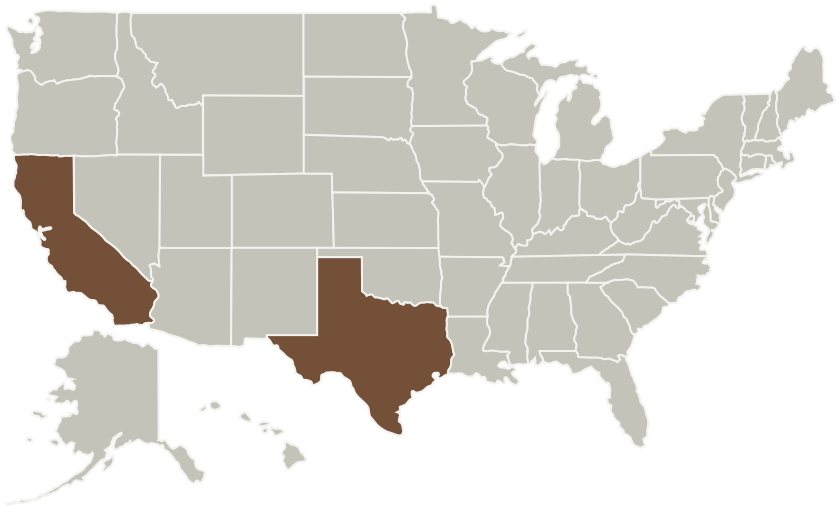
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
California Institute of Technology(CalTech)	Supporting Organization	Academia	Pasadena, California

Primary U.S. Work Locations	
California	Texas

Project Management

Program Director:
Carolyn R Mercer

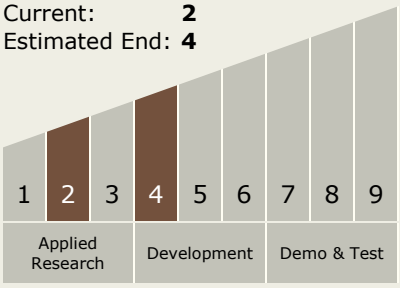
Program Manager:
Haris Riris

Principal Investigator:
Maria F Mora

Co-Investigators:
Carlos D Garcia
Peter A Willis
Aaron C Noell
Karen R Piggee

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **4**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.3 In-Situ Instruments and Sensors
    - TX08.3.4 Environment Sensors

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Target Destination

Others Inside the Solar System